ELECTRICAL CONNECTOR DEVICE FOR USE WITH ELEVATOR LOAD BEARING MEMBERS

Field of the Invention

This invention generally relates to electrical connectors for making a conductive connection with at least one tension member in an elevator load bearing member.

Description of the Related Art

Elevator systems typically include a load bearing member such as a rope or belt that bears the weight of the car and counterweight and allows the car to be moved as desired within the hoistway. For many years, steel ropes were used. More recently, coated steel belts have been introduced that include a plurality of tension members encased within a jacket. In one example, the tension members are steel cords and the jacket comprises a polyurethane material.

The new arrangements present new challenges for monitoring the load bearing capabilities of the load bearing member over the life of the elevator system.

A variety of techniques for monitoring modern elevator load bearing members are being developed. This invention provides the ability to readily and accurately establish an electrically conductive connection with at least one of the tension members to facilitate an electricity-based monitoring technique.

SUMMARY OF THE INVENTION

In general terms, this invention is a device for making an electrical connection with at least one tension member of an elevator load bearing member.

One example device includes at least one electrical connector member that is adapted to penetrate through a coating over a tension member. A clamping member is received on at least one side of the coating and supports the electrical connector member. Circuitry for processing information gathered by the connector member and including at least one shorting conductor for electrically coupling at least two tension members is supported by the clamping member.

In one example, the clamping member has first and second portions that are received on opposite sides of the load bearing member. The adjuster causes the first and second portions to move toward each other so that the connector member is urged into contact with the tension member.

An example elevator load bearing assembly includes a plurality of tension members encased within a non-conductive jacket. At least one electrical connector member extends at least partially through the jacket to make an electrically conductive contact with at least one of the tension members. A clamping member received on an outside of the jacket supports the electrical connector. The clamping member also supports circuitry for processing information gathered from the electrical connector member.

The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 schematically illustrates selected portions of an elevator system.

Figure 2 schematically illustrates an elevator belt to which an example embodiment of a connector device designed according to this invention is secured.

Figure 3 is a cross-sectional view along the lines 3-3 in Figure 2.

Figure 4 is a cross-sectional illustration taken along the lines 4-4 in Figure 2.

Figure 5 is a cross-sectional illustration similar to Figure 3 of another example connector designed according to an embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 schematically illustrates selected portions of an elevator system 20. A car 22 moves with a counterweight 24 within a hoistway 26 in a conventional manner. A load bearing member 30 supports the weight of the car 22 and counterweight 24 and interacts with at least one drive sheave of a machine (not illustrated) to cause the desired movement of the car and counterweight within the hoistway.

Figure 2 schematically illustrates a portion of one example load bearing member 30, which is a coated steel belt. The example of Figure 2 is for discussion purposes and this invention is not necessarily limited to a particular style of belt or load bearing member. In this example, a plurality of tension members 32 extend longitudinally (i.e., the direction L shown in Figure 2) within the belt 30. In one example, the tension members 32 each comprise steel strands that are wound into a cord in a conventional manner.

The tension members 32 are encased in a jacket 34, which in one example comprises a polyurethane material.

As schematically shown in Figure 2, the belt 30 has an electrical connector device 40 associated with it. As best appreciated from Figures 3 and 4, the connector device 40 has a plurality of electrical connector members 42. One end 44 of the connector members 42 is configured to be able to pierce through the jacket 34 on the belt 30 such that the connector members 42 make electrical contact with the tension members 32. In one example, the connector members 42 comprise steel.

The illustrated example includes a clamping member 45 having a first portion 46 and a second portion 48. The first and second portions 46 and 48 are received on opposite sides of the belt 30. An adjuster 50 facilitates manipulating the first portion 46 relative to the second portion 48 such that the ends 44 of the connector members 42 are urged through the jacket material 34 into electrically conductive contact with the tension members 32. In the illustrated example, the adjuster 50 includes at least a partially threaded exterior 52 that is received within a correspondingly threaded receiver portion 54 on the second portion 48 of the clamping member. By rotating the adjusters 50, the first and second portions of the clamping member 45 are drawn together, which urges the connector members 42 through the jacket material 34 into electrical contact with the tension members 32. In one example, the adjustors 50 and receiver portions are configured (by timing the threads, for example) to provide a visible confirmation of a full connection between the connector members 42 and tension members 32.

In other examples, the clamping members are urged together in a different manner and other arrangements are used to hold the connector device in place.

As can be appreciated from Figure 3, the connector device 40 includes at least one connector member 42 corresponding to each of the tension members 32 within the belt 30. As can be appreciated from Figure 4, each tension member 32 preferably is contacted by more than one electrical connector member 42, which provides redundancy in the event that one of the connector members 42 associated with a particular tension member 32 breaks or otherwise fails to establish or maintain sufficient contact.

In one example, the clamping member portions 46 and 48 are made from a non-conductive, plastic material. In the illustrated example, the first portion 46 supports the connector members 42 and a printed circuit board 60. At least circuitry and one electronic component 62 such as a microprocessor chip, for example, is supported by the example printed circuit board 60 for gathering and processing information from at least one connector member 42. Although not specifically illustrated, circuit traces on the circuit board 60 may facilitate interconnections between the connectors 42 and other electronics of a belt condition monitoring system.

In the illustrated example, the printed circuit board 60 and supported electronics 62 are housed within a housing 64 that is secured to the first portion 46 of the clamping member 45. In one example, the circuitry on board the first portion 46 is capable of providing an output that indicates a condition of a tension member or the entire load bearing member.

As can be appreciated from Figure 4, the circuit board 60 facilitates securing a coupling device 66 having at least one lead 68 for communicating power and/or control signals to the connector members 42 for appropriate monitoring of the tension members 32. In another example, battery power and wireless signal transmissions are used and there is no lead making a hand wired connection with another device.

Figure 5 illustrates another example embodiment similar to the view of Figure 3. In this example, selected connector members 42 are interconnected by circuit traces 70 supported on the printed circuit board 60. The circuit traces 70 effectively short one connector to the other and establish the possibility for having a continuous conductive path extending along some or all of the tension members 32 within the belt 30. For example, the left-most tension member may be one end of the continuous

circuit path and the right-most tension member 32 may be an opposite end of the circuit with all of the intermediate tension members 32 being branches along the circuit path. One example embodiment has a first connector device near one end of a belt like that shown in Figure 3 and a separate connector device as shown in Figure 5 near an opposite end of the belt. Such an arrangement yields a series coupling of the tension members along the belt.

Depending on the particular monitoring strategy and associated components chosen, those skilled in the art will be able to design appropriate connections with the connector members 42 to establish the desired operation. With the illustrated connectors, one example monitoring technique is resistance-based. One example technique is disclosed in the published application WO 00/5376. The teachings of that document are incorporated by reference into this description. Given this description, those skilled in the art will be able to select from appropriate materials for forming the various components of an electrical connector device designed according to this invention.

By integrating the circuitry, electronics and housing into the clamping device, this invention presents a more economical and reliable approach to making electrical connections with tension members within an elevator belt. The unique arrangement of components allows for simple and reliable installation of a connector device for establishing electrically conductive connections.

The preceding description is exemplary rather than limiting in nature. Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this invention. The scope of legal protection given to this invention can only be determined by studying the following claims.